

STATE OF CALIFORNIA
Department of Transportation
Specification for
Sprayable Thermoplastic Traffic Striping Material,
White and Lead-Free Yellow

1.0 SCOPE

This specification covers a hot-melt, retroreflective, thermoplastic traffic marking material that is suitable for producing durable traffic stripes and pavement markings on Portland cement concrete or asphalt concrete pavements. This material is heated and applied to road surfaces in a molten state using a mechanical applicator. While still hot, reflectorizing glass beads are applied to the surface of the applied thermoplastic striping material. Upon cooling to normal pavement temperatures this material shall produce durable, adherent, retroreflective traffic stripes and pavement markings that are capable of resisting deformation by traffic.

2.0 APPLICABLE SPECIFICATIONS

The following specifications, test methods and standards in effect on the opening date of the Invitation for Bid form a part of this specification where referenced.

- California Test Method, CT 423
- California Department of Transportation, Standard Specifications, latest revision
- Federal Standard Designation: No. 595b, color #33538.
- American Association of State Highway and Transportation Officials, (AASHTO) Designation: M 247.
- American Society for Testing and Materials, (ASTM) Designations: D 476, D 3335, D 3718, D 4563, D 4764, D 5380, E 11 and E 1710.
- Commission International de l'Eclairage (C.I.E.) 1931 Chromaticity Diagram.
- California Code of Regulations: Title 22.

3.0 REQUIREMENTS

3.1 Composition:

The thermoplastic material shall be composed of 100% solids. The binder shall consist of hydrocarbon or alkyd thermoplastic resins which are homogeneously blended together with all necessary prime pigments, fillers, glass beads and additives to produce a traffic striping material that meets the requirements as specified herein. The type of resin binder (alkyd or hydrocarbon) may be specified in the purchase order. All thermoplastic material shall be free from; lead, chromium, cadmium, barium and other toxic metals.

3.1.1 White Material:

White thermoplastic shall contain a minimum of 10% (by weight) of titanium dioxide pigment meeting ASTM Designation: D476 Type II (Rutile). The titanium dioxide content will be determined using ASTM Designations: D 4563, D 4764, D 5380 or other x-ray diffraction analysis method. White thermoplastic must meet the Retroreflectivity requirement when applied with drop-on glass beads.

3.1.2 **Lead-Free Yellow Material:**
 Lead-Free (L/F) yellow thermoplastic shall contain proper amounts of C.I. Pigment Yellow 83 (opaque version) and titanium dioxide (Rutile) to produce a yellow material that has a weather-fast and heat stable yellow color which meets the yellow color, reflectance, color stability (accelerated weathering) and retroreflectivity requirements as stated herein. Other pigments may be added to achieve these color requirements. The L/F yellow thermoplastic material shall appear yellow during both daytime and nighttime conditions when applied with drop-on beads.

3.1.3 **Other Ingredients:**
 The remainder of the thermoplastic composition shall be determined by the manufacturer - within the constraints of the requirements below. It shall be the manufacturer's responsibility to produce a thermoplastic material containing the necessary plasticizers, antioxidants, and other additives so that the thermoplastic will retain its color, viscosity and all other properties as specified herein. In addition to being essentially lead and chromium free, the thermoplastic shall not contain any hazardous materials at levels that would cause the thermoplastic to be classified as a hazardous waste under Title 22, Division 4, section 66261.20 of the California Code of Regulations.

3.2 **Form:**
 The thermoplastic material shall be supplied in either block or granular form as requested in the purchase order.

3.3 **Application Type/Viscosity:**
 The thermoplastic material shall be suitable for air-atomized spray application at temperatures between 350°F and 400°F. The viscosity of the molten material at these temperatures shall be suitable for applying thermoplastic traffic stripes that are ~40 mils thick.

3.4 **Characteristics of the Finished Thermoplastic:**
 Use California Test Method, CT 423 unless otherwise specified.

3.4.1 Glass Bead Content, intermixed, meeting AASHTO Designation: M 247 Type I, percent by weight	<u>White</u> 30-35	<u>L/F Yellow</u> 30-35
3.4.2 Binder Content, percent by weight, minimum.	<u>White</u> 25	<u>L/F Yellow</u> 25
3.4.3 Inert Fillers, insoluble in hydrochloric acid, percent passing a U.S. Standard No. 100 sieve, percent by weight, minimum, ASTM Designation: E 11.	<u>White</u> 100	<u>L/F Yellow</u> 100
3.4.4 Titanium Dioxide (Rutile) Pigment meeting ASTM Designation: D476 Type II, analyze titanium dioxide content using	<u>White</u> 10	<u>L/F Yellow</u> ---

ASTM Designation: D 4563, D 4764, D 5380
or California Test 402, percent by weight, minimum.

3.4.5	Specific Gravity, maximum,	<u>White</u> 2.10	<u>L/F Yellow</u> 2.10
3.4.6	Ring and Ball Softening Point,	<u>White</u> 90°-121°C	<u>L/F Yellow</u> 90°-121°C
3.4.7	Perform the remaining tests on the material after 4 hours heating with stirring at $191 \pm 2^{\circ}\text{C}$. These 4 hours includes time required (~1 hr.) for melting and temperature stabilization of the 6000 g (13 lb) sample.		
3.4.7.1	Tensile Bond Strength to an unprimed portland cement concrete brick, 63 mil thick film draw down at 191°C , tested at $25 \pm 2^{\circ}\text{C}$, psi, minimum,	<u>White</u> 180	<u>L/F Yellow</u> 180
3.4.7.2	Brookfield Thermosel Viscosity, Spindle SC4-27, 20 rpm at 191°C , Poise,	<u>White</u> <20	<u>L/F Yellow</u> <20
3.4.7.3	Impact Resistance, 63 mil thick draw down on an unprimed portland cement concrete brick. Test at $25 \pm 2^{\circ}\text{C}$, inch-pounds,	<u>White</u> >50	<u>L/F Yellow</u> >50
3.4.7.4	Daytime Luminance Factor	<u>White</u> 82 Minimum	<u>L/F Yellow</u> 42 to 59
3.4.7.5	Yellow Color, shall match Federal Standard 595B, color #33538 and shall lie within the following chromaticity limits “colorbox” defined by plotting the following four (x,y) pairs on a C.I.E. 1931 Chromaticity diagram; (x1,y1) = (0.5125, 0.4866) (x2,y2) = (0.4865, 0.4647) (x3,y3) = (0.5000, 0.4416) (x4,y4) = (0.5348, 0.4646) Follow the spectrophotometer manufacturers instructions to obtain the (x,y) chromaticity coordinates.	<u>White</u> ---	<u>L/F Yellow</u> Pass
3.4.7.6	Yellowness Index, maximum	<u>White</u> 8	<u>L/F Yellow</u> ---

- 3.4.7.7 Color Stability after Accelerated Weathering,
Prepare sample by dipping an aluminum panel into the molten thermoplastic and removing it to obtain a 40 to 80 mil coating thickness of thermoplastic on the panel.
Material must meet the color stability requirements below after 500 hours in the weathering apparatus.

	<u>White</u>	<u>L/F Yellow</u>
White - Yellowness Index, maximum	20	---
Yellow - Measured chromaticity coordinates must fall within a "colorbox" defined by plotting the following four (x,y) pairs on a C.I.E. 1931 Chromaticity diagram. (x1, y1) = (0.5125, 0.4866) (x2, y2) = (0.4650, 0.4466) (x3, y3) = (0.4750, 0.4251) (x4, y4) = (0.5348, 0.4646)	---	Pass

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|---------|--------------------------------|--------------------------|-------------------------------|
| 3.4.7.8 | Hardness, Shore A-2 Durometer, | <u>White</u>
20 to 65 | <u>L/F Yellow</u>
20 to 65 |
|---------|--------------------------------|--------------------------|-------------------------------|

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|---------|---|--------------------|-------------------------|
| 3.4.7.9 | Abrasion Test, total weight loss, grams, maximum. | <u>White</u>
10 | <u>L/F Yellow</u>
10 |
|---------|---|--------------------|-------------------------|

- | | | | |
|----------|--|--------------------|-------------------------|
| 3.4.7.10 | Lead, mg/kg in thermoplastic, maximum, ASTM Designation: D3335 | <u>White</u>
20 | <u>L/F Yellow</u>
20 |
|----------|--|--------------------|-------------------------|

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|----------|--|-------------------|------------------------|
| 3.4.7.11 | Chromium, mg/kg in thermoplastic, maximum, ASTM Designation: D3718 | <u>White</u>
5 | <u>L/F Yellow</u>
5 |
|----------|--|-------------------|------------------------|

- | | | | |
|----------|---|---------------------|--------------------------|
| 3.4.7.12 | Initial Retroreflectivity of applied thermoplastic striping (with beads), $\text{mcd} \cdot \text{m}^{-2} \cdot \text{lx}^{-1}$, minimum | <u>White</u>
250 | <u>L/F Yellow</u>
175 |
|----------|---|---------------------|--------------------------|

The thermoplastic shall produce delineation and pavement markings that have the required minimum level of retroreflectivity when applied with drop-on beads. Drop-on glass beads shall be uniformly applied at a minimum rate of 8 lbs of beads per 100 square feet of thermoplastic. The retroreflectivity shall be measured as specified in ASTM Designation: D6359 using a retroreflectometer meeting ASTM Designation: E1710.

- 3.4.7.13 Color after Application
The daytime color of the applied white and yellow thermoplastic traffic stripes and pavement markings (with drop-on beads) shall meet the color requirements in section 3.4.7.7 (Color Stability after Accelerated Weathering). The color shall be measured within 60 days of application with the instrument described in CT 423, Part 13.

3.5 Other Requirements:

3.5.1 Applicability:

The molten thermoplastic material shall be readily applied at temperatures between 350°F and 400°F. When heated, the thermoplastic material shall completely melt to a homogeneous fluid with satisfactory application qualities and shall be free of debris. Upon application to the pavement, the thermoplastic material shall be sufficiently tack-free to carry traffic in not more than 2 minutes when the pavement surface temperature is 60°F, and in not more than 10 minutes when the pavement surface temperature is 130°F.

3.5.2 Workmanship:

The materials' ingredients (resins, pigments, glass beads, fillers and additives) shall be homogeneously blended. The finished product shall be uniform from bag to bag. The melted thermoplastic material shall have no indications of resin separation or incompatibility of resins when melted or after cooling. The material shall be free from all dirt, water, foreign matter, unmeltable debris and other deleterious substances capable of clogging screens, valves, pumps and other striping apparatus. The thermoplastic material shall be of such composition that it will not bleed, stain, or discolor when applied to pavements.

3.5.3 Shelf Life:

The material shall maintain the requirements of this specification for a minimum period of one (1) year from the date of manufacture. Any materials failing to do so shall be replaced at the expense of the manufacturer. Ordered thermoplastic shall be no more than 120 days old (based on date of manufacture) upon delivery to a Department of Transportation Maintenance facility. The date of manufacture shall be clearly marked on each bag of thermoplastic.

3.5.4 Air Pollution Compliance:

This material shall comply with all applicable air pollution control rules and regulations. The thermoplastic material shall not emit fumes that are toxic or injurious to persons or property when it is heated to application temperature. The material shall not emit excessive smoke during heating or application.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Inspection and Sampling:

All thermoplastic material intended for use by the California Department of Transportation (Department) must be sampled, tested and approved by the Transportation Laboratory **before** shipment.

Manufacturers shall take representative samples of each lot of thermoplastic and ship the samples to the Transportation Laboratory. Two (duplicate) 6000 g (13 lb) samples of each lot of thermoplastic are required to be sent to the Transportation Laboratory for testing unless other arrangements have been made.

A lot shall consist of a batch or consecutive batches of thermoplastic manufactured on the same day using the same formulation. A batch shall be that amount of thermoplastic that was manufactured and packaged in a single operation. Thermoplastic from the same lot shall be palletized, shrink-wrapped, labeled with the manufacturer's lot and batch numbers (on each

pallet) and batch number (on each bag) and stored in a common area to facilitate random sampling of the entire lot by an Inspector. A lot shall be more than 2000 lbs and less than 44,000 lbs of thermoplastic.

Manufacturers must submit the following information along with the two representative 13 lb samples of each lot for testing.

1. State Specification number (PTH-02SPRAY).
2. Manufacturer's Product number
3. Color; (White or Lead-Free Yellow) and lbs. represented by samples.
4. Identification numbers of batches comprising the lot, and lot number.
5. Date of manufacture.
6. Form (block or granular).
7. Viscosity (Sprayable)
8. Binder Type (hydrocarbon or alkyd).
9. Sampling method (splitting, thieving, quartering, random bag, etc.).
10. Purchase Order or Contract number.

A manufacturer's test report shall also be included with the representative duplicate samples of each lot sent to the Transportation Laboratory. The following information shall be included in the manufacturer's test report:

- Brookfield Thermosel Viscosity @ 375°F (191°C)
- Hardness
- Binder Content
- Glass Bead Content
- Daytime Luminance Factor
- Yellow Color (for yellow only)
- Yellowness Index (for white only)

The samples and above information shall be sent to the Transportation Laboratory at the address listed in section 6.4. A Certificate of Compliance (see section 6.1) shall accompany the samples.

Once the Transportation Laboratory approves a lot of thermoplastic, the manufacturer will be notified that the lot/batch is approved for shipment.

When shipments of the approved lots/batches of thermoplastic are made to a Department Maintenance facility, the manufacturer shall fax the following information to the Transportation Laboratory within 48 hours of the shipping date. Out of State manufacturers shall also fax the following information to the Transportation Laboratory whenever shipments of approved lots/batches are shipped to warehouses, resellers, or Contractors within the State of California.

- State Specification number (PTH-02SPRAY).
- A list of each delivery locations and delivery dates.
- Name and phone number of contact person(s) at the delivery location(s).
- Colors, batch/lot numbers and quantity of material comprising shipment.
- Purchase Order number or Contract number and date that order was received.

This information shall be faxed to: Transportation Laboratory, Chemical Testing Branch, 5900 Folsom Blvd., Sacramento, CA 95819-4612, attn.: Lisa Dobeck, Fax (916) 227-7168.

- 4.2 The Department reserves the right to take random samples of lots/batches of thermoplastic destined for use by the Department, at the manufacturer's facility. Sampling may also be done at the Contractor's warehouse or jobsite. If requested by the Inspector, batch tickets must also be provided for batches of thermoplastic produced for the Department.

The Department also reserves the right to retest any batch/lot of thermoplastic after delivery. Results from such retesting shall prevail over all other tests and will be the basis of rejection. Material not meeting the specification shall be removed and replaced by the supplier at their expense, including all costs for handling, retesting and shipping.

- 4.3 **Testing:**
All tests shall be performed according to the specified test methods, latest revision. Qualitative and quantitative analysis may also be performed by other methods of analysis, at the option of the Department. The manufacturer shall maintain a laboratory sufficiently staffed and equipped so as to maintain the quality of the product as called for in these specifications.

5.0 PREPARATION FOR DELIVERY

5.1 Packaging:

5.1.1 Block Form:

The thermoplastic material shall be packaged in suitable containers to which it will not adhere nor interact during shipment and storage. The blocks of cast thermoplastic material shall be approximately 35 by 12 by 2 inches and shall weigh approximately 50 lb. The containers shall be palletized as specified in the contract or purchase order.

5.1.2 Granular Form:

The thermoplastic material shall be packaged in meltable bags which are compatible with the thermoplastic and which weigh approximately 50 lb when filled. The containers must have sufficient strength and be properly sealed to prevent breakage and leakage during normal handling. The bags shall be shrink-wrapped to reduce shifting of the bags on the pallet and shall be palletized as specified in the contract or purchase order.

5.2 Markings:

Each individual unit/container of product shall be labeled. This label shall include: State Specification number (PTH-02SPRAY), color, type of binder, manufacturer's name and address, date of manufacture and batch number. Lead-free yellow materials shall be marked "Lead-Free". All markings on containers shall be legible and permanent. Markings shall not smear or rub off container. Containers failing to meet marking requirements will not be accepted.

The containers and labeling shall meet all applicable US Department of Transportation and Interstate Commerce Commission regulations. Concerning the content, each container shall be

labeled with such warnings or precautions as are required by Local, State and Federal laws and requirements.

6.0 NOTES

6.1 Certificates of Compliance:

The manufacturer of thermoplastic materials shall furnish the Engineer with a Certificate of Compliance in conformance with the provisions of the California Department of Transportation Standard Specifications, latest revision, section 6-1.07, "Certificate of Compliance." The Certificate shall also include a list, by title and section, of all applicable State and Federal packaging and labeling laws and a statement that all requirements have been met. Certificates of Compliance shall be sent along with each delivery of thermoplastic and also with samples sent to the Transportation Laboratory for testing.

6.2 Material Safety Data Sheets:

Material Safety Data Sheets (MSDSs) shall be provided by the manufacturer with each delivery of thermoplastic. These MSDSs shall include health hazard information on the material when it is heated to an application temperature of 375°F

6.3 Patents:

The Contractor shall assume all costs arising from the use of patented; materials, equipment, devices or processes used on or incorporated in the work, and further agrees to indemnify and save harmless the State of California and its duly authorized representatives from all suits at law or action of every nature for or on account of the use of any patented; materials, equipment, devices or processes.

6.4 Contact Information:

Please send the representative samples of each lot to,

California Department of Transportation
Transportation Laboratory – Chemistry Branch
5900 Folsom Blvd.
Sacramento, CA 95819
Attention: Andy Rogerson
Fax: (916) 227-7168

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